

8100104

THE DATKHED SHAVES OF AMERICA

Cornell Agricultural Experiment Station

Withereas, there has been presented to the

Secretary of Agriculture

AN APPLICATION REQUESTING A CERTIFICATE OF PROTECTION FOR AN ALLEGED NOVEL VARIETY OF SEXUALLY REPRODUCED PLANT, THE NAME AND DESCRIPTION OF WHICH ARE CONTAINED IN TO AN OUTS A COPY OF WHICH IS HEREUNTO ANNEXED AND MADE A PART HEREOF, AND THE VARIOUS REQUIREMENTS OF LAW IN SUCH CASES MADE AND PROVIDED HAVE BEEN COMPLIED WITH, AND THE TITLE THERETO IS, FROM THE RECORDS OF THE PLANT VARIETY PROTECTION OFFICE, IN THE APPLICANT(S) INDICATED IN THE SAID COPY, AND WHEREAS, UPON DUE EXAMINATION MADE, THE SAID APPLICANT(S) IS (ARE) ADJUDGED TO BE ENTITLED TO A CERTIFICATE OF PLANT VARIETY PROTECTION UNDER THE LAW.

NOW, THEREFORE, THIS CERTIFICATE OF PLANT VARIETY PROTECTION IS TO GRANT UNTO THE SAID APPLICANT(S) AND THE SUCCESSORS, HEIRS OR ASSIGNS OF THE SAID APPLICANT(S) FOR THE TERM OF eighteen YEARS FROM THE DATE OF THIS GRANT, SUBJECT TO THE PAYMENT OF THE REQUIRED FEES AND PERIODIC REPLENISHMENT OF VIABLE BASIC ED OF THE VARIETY IN A PUBLIC REPOSITORY AS PROVIDED BY LAW, THE RIGHT TO EXECUTE OTHERS FROM SELLING THE VARIETY, OR OFFERING IT FOR SALE, OR REPRODUCING IT, ORTING IT, OR EXPORTING IT, OR USING IT IN PRODUCING A HYBRID OR DIFFERENT THEREFROM, TO THE EXTENT PROVIDED BY THE PLANT VARIETY PROTECTION ACT.

NITED STATES SEED OF THIS VARIETY (1) SHALL BE SOLD BY VARIETY NAME ONLY AS THE OWNER OF THE RIGHTS. (84 STAT. 1542, AS AMENDED, 7 U.S.C. 2321 ET SEQ.)

FIELD BEAN

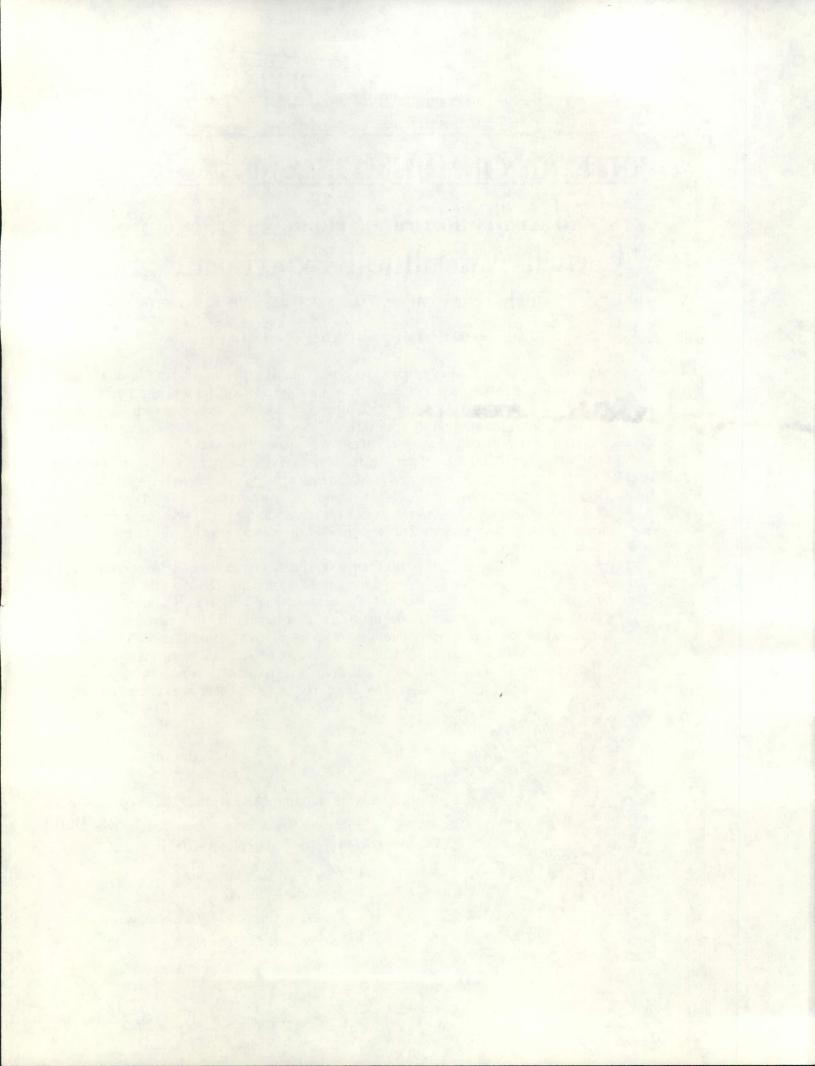
'Midnight'

In Testimony Wancroot, I have hereunto set my hand and caused the seal of the Plant Variety Protection Office to be affixed at the City of washington this 11th day of March in the year of our Lord one thousand nine hundred and eighty-two.

Acting
Commissioner
Plant Variety Protection Office
Grain Division

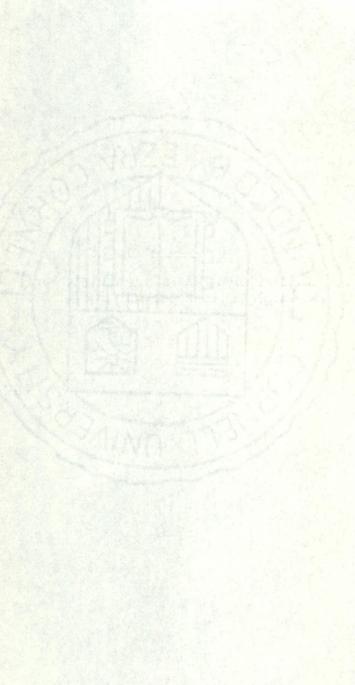
Agricultural Marketing Service

In R Block Secretary of Agriculture



Item 5

It was determined that Midnight was a new variety April 3, 1980. Breeder and foundation seed increase began the summer of 1980.





Item 13a

- (1) Midnight (Phaseolus vulgaris L.) is a bulk of N.Y. lines 70001, 70002, 70003 and 70004. The 4 lines originally were 1976 single plant selections from the International Center of Tropical Agriculture (CIAT) field bean germ plasm accession no. G.O. 3627. The planting from which the selections were made was at the Cornell Agronomy Research Farm, Aurora, New York.
- (2) Seed of each selection was increased in the greenhouse during the winter of 1976-77. Because it was evident in 1977 that each line was promising as a variety each was sent in the spring of 1978 to the Idaho Seed Bean Company, Twin Falls, Idaho in order to maintain a seed source free of halo and common blights. These seed borne diseases are not common in Idaho but are common in New York. The lines were maintained separately in Idaho and bulked in September of 1980 when no distinguishable differences in them could be observed.
- (3) The very few variants which occurred were nearly all plants with long runners in contrast to the bush like plant habit of Midnight.
- (4) The vining type plants occurred with a frequency of 1 in 1000 in 1979 and were rogued out. They occurred at a rate of 1 in 50,000 (estimated) in 1980. Again they were rogued out.

RECEIVED

MAR 23 1981

OF ACTION AND ADDRESS OF ACTION AND ADDRESS

AMS, LPG&S DIV.

INSTRUCTIONS

GENERAL: Send an original copy of the application and exhibits, at least 2,500 viable seeds, and \$500 fee (\$250 filing fee and \$250 examination fee) to U.S. Dept. of Agriculture, Agricultural Marketing Service, Livestock, Poultry, Grain and Seed Division, Plant Variety Protection Office, National Agricultural Library Building, Beltsville, Maryland 20705. (See section 180.175 of the Regulations and Rules of Practice.) Retain one copy for your files. All items on the face of the form are self-explanatory unless noted below.

PVPO

AMS, LPG&S DIV.

ITEM

- Give the date the applicant determined that he had a new variety based on (1) the definition in section 41(a) of the Act and (2) the date a decision was made to increase the seed.
- the Act and (2) the date a decision was made to increase the seed.

 13a Give: (1) the genealogy, including public and commercial varieties, lines, or clones used, and the breeding method; (2) the details of subsequent stages of selection and multiplication; (3) the type and frequency of variants during reproduction and multiplication and state how these variants may be identified and (4) evidence of uniformity and stability.
- Give a summary statement of the variety's novelty. Clearly state how this novel variety may be distinguished from all other varieties in the same crop. If the new variety most closely resembles one or a group of related varieties:

 (1) identify these varieties and state all differences objectively; (2) attach statistical data for characters expressed numerically and demonstrate that these differences are significant; and (3) submit, if helpful, seed and plant specimens or photographs of seed and plant comparisons clearly indicating novelty.
- 13c Fill in the Exhibit C, Objective Description form, for all characteristics for which you have adequate data.
- Describe any additional characteristics that are not described, or whose description cannot be accurately conveyed in Exhibit C. Use comparative varieties as is necessary to reveal more accurately the description of characteristics that are difficult to describe, such as, plant habit, plant color, disease resistance, etc.
- 14a If "YES" is specified (seed of this variety be sold by variety name only as a class of certified seed) the applicant may NOT reverse his affirmative decision after the variety has either been sold and so labeled, his decision published, or the certificate has been issued. However, if the applicant specified "NO," he may change his choice. (See section 180.16 of the Regulations and Rules of Practice.)
- See section 42 of the Plant Variety Protection Act and section 180.7 of the Regulations and Rules of Practice.

UNITED STATES DEPARTMENT OF AGRICULTURE FORM APPROVED AGRICULTURAL MARKETING SERVICE LIVESTOCK, POULTRY, GRAIN & SEED DIVISION OMB NO 40-B3822 No certificate for plant variety protection may APPLICATION FOR PLANT VARIETY PROTECTION CERTIFICATE be issued unless a completed application form has been received (5 U.S.C. 553). INSTRUCTIONS: See Reverse, TEMPORARY DESIGNATION OF 1b. VARIETY NAME FOR OFFICIAL USE ONLY VARIETY PV NUMBER Midnight Midnight 8100104 KIND NAME 3. GENUS AND SPECIES NAME FILING DATE TIME A.M. Black Turtle Soup Phaseolus vulgaris L. 5/1/81 12:00 P.M. Field Bean FEE RECEIVED DATE FAMILY NAME (BOTANICAL) 5. DATE OF DETERMINATION 4/1/81 500.00 Leguminosae 4/3/80 250.00 11/24/81 NAME OF APPLICANT(S) 7. ADDRESS (Street and No. or R.F.D. No., City, State, and ZIP 8. TELEPHONE AREA Code) CODE AND NUMBER Cornell Agricultural (607) 256-5420 Experimental Station Cornell University, Ithaca, NY 14853 IF THE NAMED APPLICANT IS NOT A PERSON, FORM OF 10. IF INCORPORATED, GIVE STATE AND 11. DATE OF INCOR-ORGANIZATION: (Corporation, partnership, association, etc.) DATE OF INCORPORATION PORATION State Agricultural Experiment Station 1888 New York NAME AND MAILING ADDRESS OF APPLICANT REPRESENTATIVE(S), IF ANY, TO SERVE IN THIS APPLICATION AND RECEIVE ALL PAPERS: Roger F. Sandsted, Department of Vegetable Crops, 164 Plant Science Building, Cornell University, Ithaca, N.Y. 14853 (607) 256-3031 CHECK BOX BELOW FOR EACH ATTACHMENT SUBMITTED: 13A. Exhibit A, Origin and Breeding History of the Variety (See Section 52 of the Plant Variety Protection Act.) X 13B. Exhibit B, Novelty Statement. 13C. Exhibit C, Objective Description of the Variety (Request form from Plant Variety Protection Office.) 13D. Exhibit D, Additional Description of the Variety. 14a. DOES THE APPLICANT(S) SPECIFY THAT SEED OF THIS VARIETY BE SOLD BY VARIETY NAME ONLY AS A CLASS OF CERTIFIED SEED? (See Section 83(a). (If "Yes," answer 14B and 14C below.) X YES NO DOES THE APPLICANT(S) SPECIFY THAT THIS VARIETY BE 14b. 14c. IF "YES," TO 14B, HOW MANY GENERATIONS OF PRODUC-LIMITED AS TO NUMBER OF GENERATIONS? TION BEYOND BREEDER SEED? YES X FOUNDATION NO REGISTERED X CERTIFIED DID THE APPLICANT(S) FILE FOR PROTECTION OF THIS VARIETY IN OTHER COUNTRIES? NO (If "Yes," give name of countries and dates.) HAVE RIGHTS BEEN GRANTED THIS VARIETY IN OTHER COUNTRIES? NO (If "Yes," give name of countries and dates.) 16. DOES THE APPLICANT(S) AGREE TO THE PUBLICATION OF HIS/HER (THEIR) NAME(S) AND ADDRESS IN THE OFFICIAL JOURNAL? YES The applicant(s) declare(s) that a viable sample of basic seed of this variety will be furnished with the application and will be replenished upon request in accordance with such regulations as may be applicable. The undersigned applicant(s) is (are) the owner(s) of this sexually reproduced novel plant variety, and believe(s) that the variety is distinct, uniform, and stable as required in Section 41, and is entitled to protection under the provisions of Section 42 of the Plant Variety Act. Applicant(s) is (are) informed that false representation herein can jeopardize protection and result in penalties. (DATE)

Item 13a (section 41(a)(3)

rec'd 10/21/81 CRB

The within variety or cultivar genetic stability of Midnight is equal to that of T39 and its uniformity is much better than that of the old standard Black Turtle Soup. The original selections which went into Midnight were made in the field in 1976. There was a winter increase of each line in the greenhouse during the winter 1976-77. Yearly field increases occurred thereafter in 1977, 1978, 1979 and 1980 (5 generations). Representatives from the seed certification agencies of North Dakota, Michigan and New York commented on the remarkable uniformity of Midnight in Idaho Foundation fields in 1981.



Item 13b for statement of most similar arrety.

The novelty of Midnight is its upright or erect habit of plant growth, indeterminant but bush type plant (CIAT type 2), its large roots and its resistance to lodging. The original plant selections were made because of their upright plant habit in otherwise decumbent plants of G.O. 3627. Under very favorable growing conditions the plants may have short runners.

(1) It is superior to the commercial black bean variety T39 in all of the preceding characteristics. See the attached reprint from Crop Science, 1979, Volume 19, pages 823-826. (T39 is now the leading commercial black bean variety in the U.S.) See also the attached data on seed yield, pod maturity and seed weight.





New York State College of Agriculture and Life Sciences a Statutory College of the State University Cornell University

Department of Vegetable Crops Plant Science Building, Ithaca, N. Y. 14853 Telephone: 607-256-4568

September 15, 1981

Ms. Rose Broome
Agriculture Marketing Service
Livestock, Poultry, Grain and
Seed Division
Plant Variety Protection Office
National Agricultural Library Bldg.
Beltsville, Maryland 20705

Dear Ms. Broome:

This letter is in response to your telephone request for information on the Midnight black bean variety.

Revision of the novelty statement ITEM 13b

The novelty of Midnight is its upright or erect habit of plant growth, large roots and resistance to lodging. Under most growing environments the plants have a bush type habit but under very favorable conditions they may produce very short indeterminate runners. The runners do not cross into neighboring rows. Most pods are relatively high on the plant. Because of the above plant characteristics Midnight is adapted to direct harvesting.

addendum to Exhibit B The leading commercial black bean most similar to Midnight is T39. This strictly indeterminate variety has a bush type plant in early stages of growth but later produces runners that intermingle in the plants of neighboring rows. With a heavy pod set T39 plants lie on the ground and are very difficult to direct harvest without a high loss of seed.

(1) For data on root size, maturity, yield and seed weight (size) see the attached reprint from Crop Science, 1979, Volume 19, page 823-826 and the mimeographed results from other trials.

Exhibit C

- 4. Leaf color should be changed from 2 to 3. I'm not sure they are as dark as those of Blue Lake 290 but they are darker than medium green.
- 6. Fresh pods Change from 7 to 2 remove the "anthocyanin present". Its there but doesn't show.

You asked for more information on pod color.

Immature - medium green
When pods begin to lighten up because of loss of chlorophyl
and approaching maturity anthocyanin shows but the concentration

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1

Ms. Rose Broome September 15, 1981 Page 2

is not heavy.

Mature dry pods - tan or light brown with a slight tint of anthocyanin.

Item 9:

Stems: I have a 2 for anthocyanen present. Actually very little if any anthocyanin shows in the stems when they are fully green but as they begin to mature it shows up. Anthocyanen is always present from the cotyledoncery node downward to the soil line.

Pods: Noted under item 6

Leaves: No anthocyanin shows in green leaves and only a very slight amount shows as the leaves begin to mature.

Item 10: Change the O for mosaic mottle to 2.

Flower Color: I gave this to you on the phone but you probably want it in writing.

Over all the flower color is a lavander. The top of the standard petal is darker than the underside. The top of the wings is darker than the undersides.

According to Maerz, A. and M. R. Paul, 1950. A Dictionary of Color. McGraw-Hill Book Company, Inc. 2nd edition, Plate 43. The top of the standard petal is K7-Lillium antique Fusia + Underside of the standard petal is D4-between plumbago blue and vanda on line 4. Top of wings is J7-Gigas purple aster. Underside of wings is E5-Diadem.

ger & Sandsted

I think you can understand the problem of coding some of the items.

Sincerely,

Roger F. Sandsted

Professor

Vegetable Crops

RFS/st Encs.



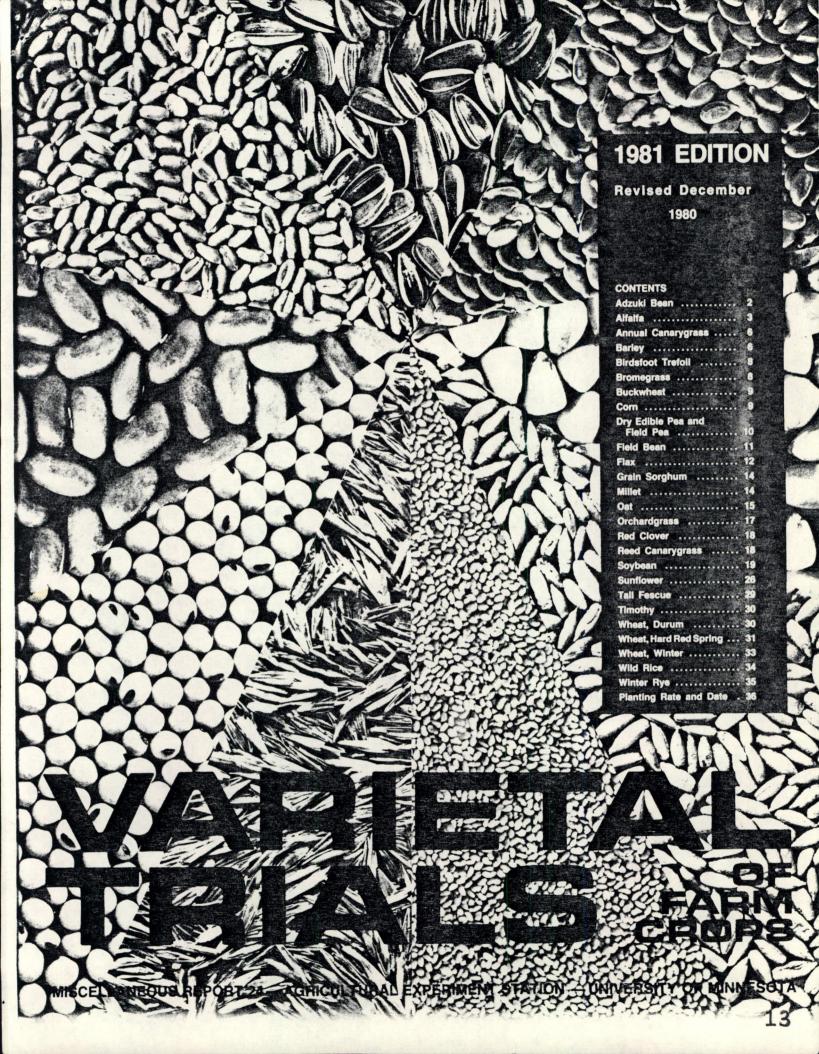
Item 13d

Flowers of Midnight are lavender but have not as yet been matched with color plates.

Some plant measurements are missing because our studies were concentrated on root size and number and the plant habit of growth (erectness and lodging).

D.S. DEPARTMENT MAR AMS, LPG&S DIV. SANLTINOIHSV SC

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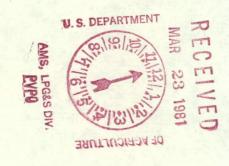


Table 1. Seed yield of Midnight (70001, 70002, 70003, 70004), T39 and Black

	lurtle Soup	(BIS) at	1/	ocations in	1 19//-19/0) .
	1977-	19774	1978-1/	19/8-	19/8-	
	Res.	Res.	Res.		N.	
	Farm	Farm	Farm	Geneva	Lansing	Average
Entry	THE PERSON NAMED IN COLUMN TWO IS NOT THE OWNER.		Pounds	/acre		
70001	2980	3135	2900	2554	2962	2906
70002	2950	3276	2868	2404	3005	2901
70003	2885	3101	2826	2597	3007	2883
70004	3022	3264	2899	2505	2921	2922
T39	2790	2997	2666	2398	2908	2752
BTS	2862	3046	2486		2816	2802
LSD.05	221	487	276	249	375	322
C.V. %	5.1	7.5	6.5	9.0	11.3	7.9

Table 1. (cont.) Pod maturity of Midnight (70001, 70002, 70003, 70004), T39 and Black Turtle Soup (BTS) at various locations in 1977-1978.

			Days			
70001	98	107	97	_	95	99.3
70002	96	104	98	-	96	99.5
70003	96	107	96	-	97	99.0
70004	99	104	97	-	97	99.3
T39	95	109	101	-	96	100.3
BTS	94	100	107	***	104	101.3
LSD.05	3.6		3.0	_	4.2	
C.V. %	2.5	-	2.3	-	3.4	

Table 1. (cont.) Seed weight (18% moisture) of Midnight (70001, 70002, 70003, 70004), T39 and Black Turtle Soup (BTS) at various locations in 1977-1978.

			-Grams/10	0		
₹70001	24	23	23	21	22	22.6
70002	25	23	23	22	22	23.0
70003	24	23	23	21	22	22.6
70004	25	22	23	22	22	22.8
T39	25	23	25	23	22	23.6
BTS	25	23	24	24	25	24.2
LSD. 05	1.0	1.7	0.9	1.6	1.3	1.3
C.V. %	2.7	3.5	2.5	3.5	3.3	3.1

^{1/ 4} replications.
2/ 2 replications.

Other breeding lines and varieties were included in the trials.



Viva Pink—Medium yield. Late maturity. Large, prostrate vine. Pink seed resistant to splitting. Resistant to mosaic V-1, V-1A. Tolerant of *Fusarium* root rot. Very susceptible to rust.

Susceptible to white mold and blight. Developed by Washington Agricultural Experiment Station and USDA from crosses involving UI-35 small red, PI 203958, and Sutter pink. Released in 1974.

Table 14. Characteristics of field bean varieties

		Seed yield/	acre (pounds)			Average—4 loca	ations
Class and variety	Lamberton 1977-80	Morris 1977-80	Crookston 1977-80	Becker ¹ 1976-78, 80	Yield/acre (pounds)	Weight/ 100 seeds (grams)	Planting to maturity (days)
Pinto							
UI-114	1969	2226	1729	2416	2085	38.3	105
Fiesta		1630 ²	1687 ²	2035 ²	1733	40.1	95
	_	1842 ²	1565 ²	2259 ²	1838	38.4	98
Gala	1684		1653 ⁴	2470	1963	33.6	105
NW-410	1617	2043 1755	1533 ⁴	2258 ⁴	1791	33.3	101
Olathe			1000				101
UI-111	1649	1854	1650	1936	1772	36.2	
Wyo 166	1742	1829	1496	22984	1841	36.5	102
Navy							
Fleetwood	1406	1565	13114	1892 ⁴	1544	17.6	105
Snow-Bunting	1322	1169	1110	1304	1226	17.8	92
Up-Land	1360	1322	1261	1361	1326	16.9	95
Bunsi	14944	1610 ⁴	1380 ⁴	1230 ³	1429	17.7	96
Sanilac	1266 ³	1120 ³	1203 ²	1400 ²	1247	17.6	100
Seafarer	1308	1051	839	1264	1116	18.1	93
Tuscola	1198	1280	952	1439	1217	17.2	105
	1130	1200	332	1400	1217	17.2	100
Small White							
Aurora	1511	1690	1420	1919-	1635	14.7	102
Great Northern							
Emerson	1920	2023	1705 ⁴	2424	2018	44.4	98
Harris	22044	22424	1841 ⁴	2226 ³	2128	36.8	104
Star	2270	2164	19824	2157	2143	36.0	108
USDA 1140	1722 ²	1820 ²	1499 ²	2238 ²	1820	33.5	108
	17,22	1020	1 100				
Small Red	1.1504	10004	10113	10003	1010	01.4	0.5
UI-37	1153 ⁴	1329 ⁴	1214 ³	1300 ³	1249	31.4	85
UI-36	1645 ²	1820 ²	1591 ²	1977 ²	1758	31.7	93
NW-59	1164 ²	1638 ²	1296 ²	1977 ²	1519	28.8	103
NW-63	1420 ²	1504 ²	1462 ²	1900 ²	1572	30.5	107
Pink							
Viva	1734	1845	1643 ⁴	1873	1774	25.4	105
Black Turtle Soup							
Black Turtle T 39	1734	1736	1395	2018	1721	18.5	100
	1734	1730	1333	2000 ²	1/21	18.0	102
Midnight		_	_	2000	_	10.0	102
Dark Red Kidney					2100		105
Montcalm	1328	1299	1250 ⁴	1753	1408	46.6	106
Light Red Kidney							
Sacramento	1118 ⁴	6954	1130 ⁴	1500 ³	1111	46.3	89
Miscellaneous							
	1349 ³	1403 ³	1148 ³	1761 ²	1415	38.0	104
Swedish Brown						30.0	104
LSD 5%	173	155	235	228	100		

¹Irrigated. ²1 year. ³2 years. ⁴3 years.

FLAX

RECOMMENDED VARIETIES

Culbert—Very high yield. Early, brown seed, blue flowers. High oil percent and very high iodine value. Resistant to rust, moderately resistant to wilt, moderately susceptible to pasmo. Released in 1975 by Minnesota Agricultural Experiment Station from a cross of Windom and Bison 70.

Dufferin—High yield when sown early, *not recommended for late sowing*. Very late, brown seed, blue flowers, variable plant height. High oil percent. Resistant to rust and wilt. Licensed in 1975 by Agriculture Canada, Ottawa from a cross of Redwood 65 and FP 441.

Linott—Very high yield. Early, brown seed, blue flowers. High oil percent and iodine value. Resistant to rust (has a trace of susceptible plants), moderately susceptible to wilt and pasmo. Licensed in 1967 by Agriculture Canada, Ottawa, from crosses involving 770B. Agreeting C. Agrow, and Cl. 974

involving 770B, Argentine C, Arrow, and CI 974.

Norstar—High yield. Medium-late, resistant to lodging, brown seed, blue flowers. High oil percent, medium to low iodine value. Moderately susceptible to rust (exhibits some field tolerance to current races), resistant to wilt, moderately resistant to pasmo. Released in 1969 by Minnesota Agricultural Experiment Station from a cross of Redwood and Crystal.

Exhibit D. Addendum

Morden, from crosses involving Century, Chancellor, and PI 162567. Licensed in 1978.

OTHER VARIETIES

Maple—Medium to low yield. Late. Long vined. Large, olivecolored seed with brown mottle and indistinct hilum. An excellent

Table 13. Characteristics of field pea varieties

variety for pigeon feed use. Grown under contract when buyers offer a higher price than for recommended varieties.

Trapper — Medium to high yield. Medium to early. Medium vine length. Small, cream-colored seed. Good cooking quality. Originated by Agriculture Canada, Morden, from a cross of Chancellor x Weibull's 700. Licensed in 1970.

-	See	ed yield/acre (pour	nds)	Weight/	Seed	Plan	ting to	Vine	
Variety	Becker	Grand Rapids	Crookston	100 seeds	protein ¹	bloom	maturity	length	
	1976-78, 80	1980	1980	(grams)	(percent)	(days)	(days)	(inches)	
Century	1616	2315	1420	21.9	26.2	57	95	37	
Paloma	2294	2465	1579	26.7	25.1	52	88	15	
Tara	1565 ²	2601	1411	19.1	26.5	57	93	33	
Trapper Maple LSD 5%	1491 ² 562 ³ 137	2425 1549 266	955 1104 303	13.0 19.3	26.3 28.3	55 67	93 107	31 48	

¹Oven-dry, 1976-78. ²Not tested in 1976. ³Not tested in 1976-77.

FIELD BEAN

Field bean is combine-harvested as mature, dry bean. It is used for human food and reaches the grocer's shelf in either canned or dry form.

There are more than 15 market classes of dry, edible bean, but only eight have been grown commercially in Minnesota. Minnesota's 1979 production amounted to 62 percent navy, 37 percent pinto, and 1 percent other classes. Varietal recommendations are confined to varieties within the navy, small white, pinto, dark red kidney, pink, black turtle soup, great northern, and small red classes. Other classes are grown successfully, but important differences among varieties within their classes have not yet been identified in our trials.

RECOMMENDED VARIETIES

Aurora small white—Medium yield. Medium-late maturity. Erect, viny bush. Very small, white seed. Resistant to rust and mosaic V-1, V-15. Tolerant of halo blight. Susceptible to common blight. Developed by New York Agricultural Experiment Station from a cross of Black Turtle Soup and Cornell 49-242. Released in 1973.

Emerson great northern—High yield. Medium-late maturity. Large, prostrate vine. Large, white seed. Resistant to V-1, V-1A mosaic. Tolerant to bacterial wilt and moderately tolerant to bacterial blight. Susceptible to white mold and rust. Developed by Nebraska Agricultural Experiment Station from a cross of GN 1140 and PI 165078. Released in 1971.

Fleetwood navy—High yield. Late. Medium-size bush. Small, white seed. Disease reactions similar to those of other navy varieties. Developed by Agriculture Canada (Harrow). Licensed in 1977.

Montcalm dark red kidney—Medium yield. Late. Large, erect bush. Very large, dark red seed. Resistant to V-1, V-15 mosaic, alpha anthracnose, and halo blight. Susceptible to white mold, beta and gamma anthracnose, and common and fuscous blights. Named and released by Michigan Agricultural Experiment Station in 1974.

Snow-Bunting navy—Medium yield. Early. Medium-size bush. Small, white seed. Resistant to V-1 mosaic and alpha and beta anthracnose. Susceptible to white mold, V-15 mosaic, and common and fuscous blights. Developed by Clarence Muehlfeld (Bridgeport, Mich.) from crosses involving Gratiot, Sanilac, Snow-Flake, and experimental navy strains. Released in 1974.

T39 black turtle soup—Medium yield. Medium-late maturity. Erect, viny bush. Small, black seed. Resistant to rust and V-1, V-1A mosaic. Susceptible to V-15 mosaic and anthracnose.



The tall, erect growth of Midnight field bean contrasts with the sprawling growth of T39. NSP's Sherce electricity-generating plant is in the background.

Selected from black turtle soup by California Agricultural Experiment Station.

UI-37 small red—Medium yield. Very early. Short, usually erect vine. Large, dark red seed. Resistant to V-1, V-1A mosaic. Susceptible to white mold and blight. Developed by Idaho Agricultural Experiment Station from a cross of UI-56 great northern and UI-34 small red. Released in 1964. Recommended only as a very early maturing field bean; other small red varieties yield more in a normal growing season.

UI-114 pinto—High yield. Late. Large, prostrate vine. Tan and brown mottled seed. Resistant to mosaic V-1, V-1A. Tolerant of halo blight and *Fusarium* root rot. Susceptible to white mold, rust, and common and fuscous blights. Developed by Idaho Agricultural Experiment Station from a cross of UI-111 pinto and J378 great northern. Released in 1965.

Up-Land navy—Medium yield. Medium maturity. Medium-size bush. Small, white seed. Resistant to V-1 mosaic and alpha anthracnose. Susceptible to V-15 mosaic, beta anthracnose, white mold and common and fuscous blights. Developed by Clarence Muehlfeld (Bridgeport, Mich.) from a cross of Snow-Flake and a navy bean mutation. Released in 1974.

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Table 4. Mean seed and biological yield, harvest index, and lodging rating for two black bean cultivars and four selected lines during 1977 and 1978 near Aurora, N.Y.

		19'	1B			19	789		x	Ī	x
Genotype	Seed yield†	Biological yield‡	Harvest index§	Lodging rating¶	Seed yield	Biological yield	Harvest index	Lodging rating#	Seed yield	Biological yield	Harvest index
	kg	/ha	%		—— kg	z/ha ——	%		kg	/ha	%
70001	3,340	5,322	63	1	3,912	5,824	67	2.5a	3,626a*	5,573a	65a
70002	3,306	5,346	62	1	3,797	5,652	67	2.4a	3,552a	5,499a	65a
70003	3,234	5,224	62	1	3,803	5,624	68	2.8a	3,518a	5,424a	65a
70004	3,387	5,395	63	1	3,822	5,647	68	2.8a	3,604a	5.521a	65a
BTS	3,207	4,931	65	4	3,310	4,948	67	4.4c	3,259b	4,939b	66a
Strain 39	3,127	4,736	66	3	3,525	5,243	67	3.6b	3,326b	4,989b	67a
x											
Seed yield	3,267b*				3,695a						
Biological yield	- I Sa The C	5,159b				5,490a					
Harvest index		a special a	63b				67a				

[†] Seed yield adjusted to 18% moisture.

5 (prostrate).

data for both field experiments were subjected to combined analysis of variance.

RESULTS AND DISCUSSION

The lines 70001, 70002, 70003, and 70004 were significantly higher in root weight than BTS or Strain 39 under field conditions (Table 1). No significant differences were noted under greenhouse conditions (Table 2), perhaps due to root restriction in the pots. Greenhouse studies may not be an effective method of evaluating the total root biomass of black beans. However, root biomass components are different among genotypes (Stoffella, et al., 1979). All lines had significantly higher shoot weights under field conditions than BTS or Strain 39, except for 70001 as compared to BTS. No significant differences were found for this parameter under greenhouse conditions. Shoot: root ratios were significantly lower for all lines than for BTS in both environments and for Strain 39 under field conditions. A significant correlation was obtained between root weight and shoot weight under field (r=0.87) and greenhouse (r=0.89) conditions.

Uprooting resistance of the four lines was significantly higher than for the two cultivars (Table 3). Uprooting resistance increased up to seed initiation stage followed by a nonsignificant increase at the next stage (full pod fill). Root weight at the full pod fill stage was lower than at seed initiation stage (Table 1) indicating that root senescence probably had begun by full pod fill. The decline in root weight may have been responsible for the lack of significant differences in uprooting resistance between seed initiation and full pod fill growth stages.

Uprooting resistance has served as a means of evaluating root strength and other root characteristics in corn [Zea may L.] (Craig, 1958; Nass and Zuber, 1971), oats (Colette, 1962; Sechler, 1961), and alfalfa [Medicago sativa L.] (Heinrichs, 1963). Our data showed a significant positive correlation (r=0.86) between root weight and uprooting resistance under field conditions. Uprooting resistance may serve as a rapid evaluation for a large root biomass in black beans. Further investigations are needed to determine if uprooting resistance can be incorporated into a breeding program.

No significant year × genotype interactions occurred for all yield parameters. In 1977 seed yield, biological yield, and HI were lower than in 1978. When pooled over both years, seed and biological yields of the four lines were higher than for BTS or Strain 39 (Table 4). No differences in HI were measured because biological yield and seed yield were proportionally higher for all lines compared with BTS and Strain 39.

Reduction in soybean seed yield, leaf area, total dry matter, and plant height of artificially lodged plants, as compared to artificially supported plants, were reported by Noor and Caviness (1978). Our results show that black bean genotypes which naturally lodge are lower in seed yield as compared to those which exhibit lodging resistance. Another dry bean line, P566, was observed to have a lower yield under artificial lodging when compared to artificial support (CIAT, 1976).

Lodging generally began after seed initiation stage and progressed until final harvest. Less lodging occurred for all lines compared to BTS or Strain 39 in both years. Root weight during full pod fill and lodging were significantly correlated (r=0.63). This suggests that increasing the total root biomass, especially before seed initiation where root senescence may begin, is of importance in reducing lodging.

In both experiments no significant stage × genotype interactions were observed for all measured root parameters, with the exception of shoot-root ratio under greenhouse conditions. Because the interactions were non-significant it may be possible to select for a larger root type among black bean lines by measuring root weight directly or indirectly (uprooting resistance) in early growth stages. Our data suggest that a greater dry weight accumulation in the roots in relation to shoots may be a major contributing factor to lodging resistance and higher seed yield in black beans. An erect plant type can be expected to reduce harvesting losses and increase physiological yields. Yield losses with combine harvesters in soybeans have been attributed to lodging (Weber and Fehr, 1966). Further investigations using the same genotypes are under way to determine if reduced harvestable yield losses and physiological yield increases are related to erect (lodge resistant) plant types.

^{8%} moisture. ‡Biological yield = (roots + stems + pods + seeds). ¶Lodging rating based upon 1 (erect) to 9 (prostrate). Average of two replications.

[§] Harvest index = (Seed yield/Biological
Lodging rating based on 1 (erect) to

Table 1. Root and shoot measurements at different stages for two black bean cultivars and four selected lines grown under field conditions.

					Me	an dry v	vt. and	shoot:re	ot ratio	at stag	ges:							
	V	egetati	ve	Flow	ver initi	ation	Pod	lelonga	tion	See	d initia	tion	F	ull pod i	fill	ī	ī	ī
Genotype	Root wt.	Shoot wt.	Shoot: root ratio	Root wt.	Shoot wt.	Shoot: root ratio	Root wt.	Shoot wt.	Shoot: root ratio	Root wt.	Shoot wt.	Shoot: root ratio	Root wt.	Shoot wt.	Shoot: root ratio	Root wt.	Shoot wt.	Shoot root ratio
		3	- %		g	- % -	-	g	% -		3	%		g	%		g	%
70001	0.16	1.2	7.5	0.48	8.1	16.6	0.99	26.2	26.7	1.72	63.4	38.0	1.31	79.3	60.3	0.93a*	35.6ab	29.8b
70002	0.12	1.1	9.0	0.55	8.1	14.9	0.99	26.3	26.5	1.60	65.7	41.2	1.42	80.6	58.5	0.94a	36.4a	30.0b
70003	0.11	1.1	10.1	0.47	7.7	16.5	1.09	29.9	27.6	1.77	67.2	39.0	1.42	80.2	56.9	0.97a	37.2a	30.0b
70004	0.13	1.1	8.6	0.54	7.0	13.3	1.01	28.8	28.7	1.80	65.3	36.7	1.38	78.8	57.4	0.97a	36.2a	29.0b
BTS	0.10	0.9	11.7	0.35	6.2	17.6	0.66	26.0	39.4	1.39	57.8	43.0	0.92	67.7	73.1	0.65b	31.7bc	36.6a
Strain 39	0.09	0.9	10.0	0.37	5.4	14.9	0.83	23.3	28.5	1.23	60.9	50.3	0.93	64.2	73.4	0.69b	30.9c	35.4a
x																		
Root wt.	0.12e	4		0.46d			0.93c			1.59a			12.3b					
Shoot wt.	0.126	1.0e		0.400	7.1d		0.000	26.7c		1.000	63.4b		12.00	75.1a				
Shoot:root ratio		1.00	9.5e			15.6d		20.10	29.6c		00.40	41.3b		. 5.14	63.3a			

^{*} Means within a column or row followed by the same letter are not significantly different at the 5% level according to Duncan's multiple range test.

Table 2. Root and shoot measurements at different stages for two black bean cultivars and four selected lines grown under greenhouse conditions.

		Mean	dry wt. and shoot	:root ratio at	stages:				
	F	lower initiati	on		Full pod fill	C. That	x	x	x
Genotypes	Root wt.	Shoot wt.	Shoot:root ratio	Root wt.	Shoot wt.	Shoot:root ratio	Root wt.	Shoot wt.	Shoot:root ratio
	g		%		g ——	%		g ——	%
70001	1.29	4.13	3.21	7.58	65.65	8.61	4.44a*	34.89a	5.91c
70002	1.62	4.56	3.08	7.27	66.11	9.09	4.44a	35.34a	6.09bc
70003	1.37	4.01	2.95	6.33	63.34	10.08	3.85a	33.68a	6.52bc
70004	1.36	4.49	3.29	6.97	64.64	9.41	4.17a	34.56a	6.35bc
BTS	1.07	3.12	3.11	6.26	77.08	12.47	3.67a	40.10a	7.79a
Strain 39	1.24	4.66	3.90	6.04	64.02	10.58	3.64a	34.34a	7.24ab
x									
Root wt.	1.33b*			6.74a					
Shoot wt.		4.16b			66.81a				
Shoot:root ratio			3.26b			10.04a			

^{*} Means within a column or row followed by the same letter are not significantly different at the 5% level according to Duncan's multiple range test.

Table 3. Mean uprooting resistance at different stages for two black bean cultivars and four selected lines grown under field conditions.

	Pres	sure requir	ed to uproot	plant at sta	ages:	
Genotypes	Vegeta- tive	Flower initiation	Pod elongation	Seed initiation	Full pod fill	x
		الم السلمة	kg			-
70001	2.64	10.22	14.68	17.00	17.39	12.38a*
70002	2.62	9.92	14.76	17.43	19.21	12.79a
70003	2.67	10.26	14.11	18.81	17.90	12.75a
70004	2.77	9.96	13.85	16.39	17.90	12.18a
BTS	2.27	8.34	12.33	14.44	15.60	10.60b
Strain 39	1.71	7.58	11.04	15.61	14.84	10.15b
x	2.45d*	9.37c	13.45b	16.60a	17.13a	

^{*} Means within a column or row followed by the same letter are not significantly different at the 5% level according to Duncan's multiple range test.

and lodging ratings and yields, respectively. Measurements were obtained approximately 35, 50, 63, 77, and 91 days after planting. Growth stages were characterized as vegetative (first trifoliate fully expanded), flower initiation (all plants with one or more blossoms), pod elongation (majority of pods 2 to 5 cm in length), seed initiation (seeds beginning to enlarge within

pods), and full pod fill (majority of pods with fully developed seeds).

A randomized complete block design with four replications and a split-plot treatment design with genotypes as main effects and stages as sub-plots was used.

Root measurements were made from two random plants excavated with a spade at a 20-cm radius around the plant to a 20-cm depth. Roots were soaked in water and washed to remove the soil. Roots and shoots were separated, oven dried, and dry weights recorded.

Uprooting resistance was measured on four random plants per experimental unit. Each plant was cut off at the first node and its base attached to one end of a cable puller with the other end attached to a milk scale. The scale was attached to a lever based on a fulcrum, which enabled a relatively even application of hand pressure to the lever. The maximum pressure reading obtained to uproot the plant, as read from the scale, was recorded.

Subjective lodging ratings were made just prior to harvesting and were based on a scale of 1 (erect) to 5 (prostrate). Two persons working independently each made five separate ratings of each genotype per replication.

Plants from two adjacent 1.5-m rows were combined to determine seed yield and biological yield (roots + stems + pods + seeds). Samples were air dried with seed yield adjusted to 18% moisture. HI was calculated as the seed yield × 100/biological yield. Means for seed yield, biological yield, and HI of each genotype were based on five samples per replication. Yield

Exhibit D. Addendum

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Root Characteristics of Black Beans. I. Relationship of Root Size to Lodging and Seed Yield1

P. J. Stoffella,² R. F. Sandsted,² R. W. Zobel,³ and W. L. Hymes²

ABSTRACT

The relationship of root size to seed yield and lodging of two black bean (*Phaseolus vulgaris* L.) cultivars, 'Black Turtle Soup' (BTS) and 'Strain 39,' was compared with that of four black-seeded lines (70001, 70002, 70003, and 70004) under both field and greenhouse conditions at different growth stages. Root weight was significantly higher for the four lines than for the two cultivars in the field, but not in the greenhouse. Shoot:root ratios were significantly lower for all the lines than for BTS in both environments and for Strain 39 under field conditions.

Combined field data for 2 years showed all four lines had significantly higher seed and biological yields than the two cultivars, although no differences were measured for harvest index. In both years the four lines lodged less than the two cultivars.

Uprooting resistance of all lines was significantly higher than for BTS and Strain 39. None of the parameters measured showed a stage × genotype interaction, except for shoot:root ratio in the greenhouse.

Our results suggest that a larger root biomass may be an important component of ledging resistance in black

an important component of lodging resistance in black beans. Erect plant types would result in decreased yield losses by direct harvesters.

Additional index words: Dry beans, Uprightness, Uprooting resistance, Lodging, Phaseolus vulgaris L.

PRY beans (Phaseolus vulgaris L.) are usually harvested by a window vested by a windrow method. Puller blades pushed along just beneath the soil surface pull plants from two adjacent rows into a windrow, which facilitates combining the beans. In recent years, some growers have begun to use a direct harvester which cuts and threshes beans in one operation. Cultivars with an erect plant habit and pods high off the ground at maturity are particularly desirable for direct harvesting. Regardless of harvesting method, erect plant types can be expected to result in lower harvest losses and improved seed quality, particularly in humid regions. Standing plants of mature dry beans dry more rapidly and withstand greater weathering than those windrowed and left on the ground (Sandsted et al., 1974).

Lodging resistance has been characterized in many field crops as the ability of the root system to anchor the plant so that it remains upright. Aycock and McKee (1975) found differences among root sizes of tobacco (Nicotiana tabacum L.) cultivars and breeding lines and suggested that a larger root mass could help reduce lodging. The spreading angle of wheat (Triticum aestivum L.) roots and lodging were highly correlated (Pinthus, 1967) and similar results with

coronal roots of oats (Avena sativa L.) were reported by Hamilton (1951).

It has also been established that lodging reduces seed yield in soybeans [Glycine max (L.) Merr.] (Cooper, 1970, 1971a, 1971b; Johnson and Pendleton, 1968), barley [Hordeum vulgare L.] (Sisler and Olson, 1951), grain sorghum [Sorghum bicolor L.] (Larson and Maranville, 1977), oats (Pendleton, 1954), and wheat (Laude and Pauli, 1956; Weible and Pendleton, 1964) 1964). However, data are lacking on the relationship of root size to uprightness and seed yield in black-seeded beans. The purpose of this study was to investigate this relationship and to evaluate differences in root characteristics between two cultivars and four selections with upright growth and lodging resistance.

MATERIALS AND METHODS

Greenhouse Experiment

Two black bean cultivars, 'Black Turtle Soup' (BTS) and 'Strain 39', and four black-seeded lines 70001, 70002, 70003, and 'Strain 39', and four black-seeded lines 70001, 70002, 70003, and 70004, were planted in the greenhouse during the spring of 1978. The lines were derived from single plants with large root type and upright plant habit. Four seeds of each genotype were planted in #2 quartz sand in 23-cm plastic pots, and were thinned to one seedling per pot after emergence. Plants were watered daily with tap water and a (2 g/liter) 20-20-20 (N, P₂O₅,K₂O) fertilizer solution was applied biweekly. A randomized complete block design with four replications was used. Measurements of root and shoot weights were taken at two growth stages. Growth stages were characterized as flower initiation (all plants with one or more blossoms) and full pod

growth stages. Growth stages were characterized as flower initiation (all plants with one or more blossoms) and full pod fill (majority of pods with fully developed seeds). At each stage, one pot per cultivar was totally immersed in water and the sand removed with relative ease by washing. Roots and shoots were separated and oven dried at 70 C for 4 days and weights recorded weights recorded.

Field Experiments

The same genotypes used in the greenhouse were grown under field conditions during the summers of 1977 and 1978 at the Cornell Agronomy Research Farm near Aurora, N. Y. A preplant treatment of EPTC (7E) (4.7 liters/ha) and trifluralin (4E) (1.2 liters/ha) was incorporated with a springtooth harrow for weed control. A combination of fertilizer at the rate of 280 kg/ha of 7-21-14 (N, P₂O₅, K₂O) with the insecticide phorate (15 G) (8 kg/ha) was banded just before planting.

Experiment 1. In 1977 the genotypes were hand planted in two-row plots which were 3.5 m in length with 76 cm between rows. Seeds within rows were spaced at 5.1 cm. A randomized complete block design with four replications was used. Subjective lodging ratings were taken just prior to harvesting on two replications using a scale of 1 (erect) to 9 (prostrate).

Plants from 3 m of each plot were harvested for seed yield and biological yield (roots + stems + pods + seeds). Samples were air dried with seed yield adjusted to 18% moisture. Harvest index (HI) was calculated as seed yield × 100/biological yield.

Experiment 2. In 1978 the genotypes were hand planted in four-row plots which were 6.4 m in length with 81 cm between rows. Seeds within rows were spaced at 5.1 cm and thinned to 15.2 cm after emergence. Each plot was randomly divided into three 2.1-m sections for root excavations, uprooting resistance,

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3. PLANT: (Cont'd)	The property of the Co			20 11 11	gerblike in Britania	Page 1 U
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	A Con		2		VIR	
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4, LEAVES:						
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2 Size: 1 =	small (Earliwax)	2 = medium	3 = large (7	Tendercrop)		
		TIN SELECT				
12181 3 2 Color: 1	= light green (as li = dark green (as d	ght or lighter th ark or darker th	ian Bountiful) ian Bush Blue La	2 = medium gree ke 290)	n	
orb per letter from R. Sand 5. FLOWERS:	steel 9 4/15/81					
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5 4 Days to 5	50% bloom					
The second second		00 4)				
6. FRESH PODS: (Edible m			ighter than Pour	v+iful\		
exterior exterior	color: 1 = light gre 2 = mediun 3 = dark gre	n green een (as dark or o	darker than Bush	Blue Lake 290)		
9/21/81	5 = golden	llow (Brittlewa: yellow (Cheroked variagated (H	ee Wax)			
Dee letter	7 = other (s	specify)	anin prese	ent		
	448	% Sieve size dis	tribution at opti	mum maturity for	non-flat pods	
	Note: I = 4.76 mm to 5.7 2 = 5.76 mm to 7.3		4 = 8.34 mm to		hill in high	
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	1	2	3	4	5	6 191 21.41. 97
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	4 sieve 0	0 cm length	0 0	mm width	00,	nm thickness
	5 sieve 0	0 cm length	0 0) mm width	00	nm thickness
	6 sieve	cm length		mm width		mm thickness
The second secon						

(Bean)

U.S. DEPARTMENT OF AGRICULTURE AGRICULTURAL MARKETING SERVICE LIVESTOCK, POULTRY, GRAIN & SEED DIVISION BELTSVILLE, MARYLAND 20705

OBJECTIVE DESCRIPTION OF VARIETY

BEAN (Phaseolus vulgaris L.

BEAN	Phaseolus vulgaris L.)	
NAME OF APPLICANT(S)	00	FOR OFFICIAL USE ONLY PYPO NUMBER
Cornell Agricultural Experiment Stati ADDRESS (Street and No. or R.F.D. No., City, State, and Zip Cod		8100104
Cornell University, Ithaca, New York		VARIETY NAME OR TEMPORARY DESIGNATION
Place numbers in the boxes (e.g. 0 8 9) for the che PLANTS. Ranges may also be given. Royal Horticultural Societ designate system used: not yet done Please answer questions appropriate the property of the chemical prope	y or any recognized color sta	ndard may be used to determine plant colors; The location of test area is <u>New York</u>
	late for your variety if the in	
1. TYPE: 1 1 = Field (dry-edible) 2 = Gard	en	The second second
2. MARKET MATURITY:	a Tomas Ca	
0 0 Days to edible pods	0 0 Da	ys to green shells
g g Days to dry seeds	who they be taken	
0 0 0 0 Heat units to edible pods	0 0 0 0 He	at units to green shells
0 0 0 Heat units to dry seeds		
1 6 No. days earlier than	1 = Tendercro 3 = Kinghorn 5 = Michelite	Wax 4 = White Kidney 62 6 = Dwarf Horticultural
Same as	7 = Bush Blue	e Lake 290 8 = Other (specify below) T39 (BTS)
0 1 No. days later than	8	
3. PLANT:		
2 1 = Deter	minate 2 = Indeterminate	e a salar sa
0 5 0 cm height		
0 0 cm shorter than [0	
Same as	0 comparison var	iety from above
0 0 cm taller than	0	
3 0 cm spread	0 0 0 N	umber primary branches near base
0 0 cm narrower than	comparison	Branching habit: 1 = compact 2 = open
width same as	0 variety from above	
0 0 cm wider than	0	
Main stalk: 1 = brittle 2 = wirey		1 = stout 2 = thin

8. SEED SHAPE AND SIZE: (Cont'd)	8100104
2 1 = truncate ends 2 = rounded ends	3 raniform OTOOTO-
2 3 gm/100 seed	
0 1 gm/100 seed lighter than	Cross sention 1 relificated 7 movet 3 moordats d mound
9" SEED SHAPE AND SEE gm/100 seed same as	comparison variety from page one
gm/100 seed heavier than	3 - better 1/4 straped
9. ANTHOCYANIN: (1 = absent 2 = present)	A Process surface (specify belovy)
2 Flowers 2 Stems 2 Pods	2 Seeds 2 Leaves
10. DISEASE RESISTANCE (0 = not tested 1 = susceptible 2 = resistant	t):
Anthracnose (specify race below) Gamma, Delta	0 Fuscous blight
Rust (specify race below)	0 Red node virus
0 Powdery mildew	O Pod mottle virus
Tusarium root rot	Bean common mosaic virus (specify strain below)
2 Pythium root rot	2 Mosaic mottle ew 9/21/81*
Rhizoctonia root rot	1 Black root
O Pythium wilt	Bean yellow mosaic virus
O Angular leaf spot	Curly top
0 Bacterial wilt	Other (specify below)
Halo blight (specify race below)	
11. INSECT RESISTANCE: (0 = not tested 1 = susceptible 2 = resistant	nt)
0 Aphids	Root knot nematode
O Leaf hopper	O Seed corn maggot
O Lygus	0 Thrips
0 Pod borer	0 Weavils
	Other (specify below)
12. PHYSIOLOGICAL RESISTANCE: (0 = not tested 1 = susceptible	2 = resistant)
O Heat O Cold O Drought	O Air pollution

11

6. FRESH PODS: (Cont'd)

- Cross section pod shape: 1 = flat 2 = oval 3 = round 4 = heart
- Creaseback: 1 = present 2 = absent 0
- Pubescence: 1 = none 2 = sparse 3 = considerable
- Spur: 1 = straight 2 = slightly curved 3 = curved
- Constrictions: 1 = none 2 = slight 3 = deep 0
- 0 Pod flesh: 1 = light 2 = medium 3 = dark
- 0 0 mm spur length
 - 0 Fiber: 1 = none 2 = sparse 3 = considerable
 - 0 Number of seeds per pod
 - 0 Surface: 1 = smooth 2 = rough
 - 0 Suture string: 1 = present 2 = absent
 - 0 Seed development (Snap Bean): 1 = slow 2 = medium 3 = fast
 - Machine harvest: 1 = adapted 2 = not adapted
 - Pod flavor: (1) Standard (Tendercrop)
 - (2) Mild Blue Lake (BBL 274)
 - (3) Strong Blue Lake (Pole FM1)
 - (4) Mild Romano (Roma)
 - (5) Strony Romano (Pole Romano)
 - (6) Other (specify) _

7. SEED COAT COLOR:

- 1 = Monochrome 2 = Polychrome
- 1 = shiny 2 dull

- Primary color:
- 1 = white 2 = yellow 3 = buff 4 = tan
- Secondary color:
- 6 = pink 7 = red 8 = purple 5 = brown
- 11
- 9 = blue 10 = black
- none 11 = other (specify) _
- Color Pattern: 1 = none 2 = splashed 3 = mottled 4 = striped 5 = flecked 6 = dotted
- Secondary color location: 1 = hilar ring (1 = spasur 3 = becaming 3 = sides
- 2 = ventral surface
- 4 = dorsal surface
- 6 = combination of location (specify below) 5 = not restricted to any area none
- Hilar ring on colored seeds: 1 = absent 2 = narrow 3 = butterfly shaped

SEED SHAPE AND SIZE:

- Hilum view: 1 = elliptical 2 = oval 3 = round
- Cross section: 1 = elliptical 2 = oval 3 = cordate 4 = round

- Side view:





1 = oval to oblong

2 = round

3 = reniform